SYNOPSIS

Title of the proposed work:

NUMERICAL STUDY OF PULSATILE FLOW THROUGH AN EXPANDED CHANNEL

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Registration No.: VB-61 of 2007-08, Date: 03.12.2013

Keywords: Pulsatile flow, channel flow, channel with symmetric expansion, Magnetic field.

It has been a well established fact that now-a-days many people both from developed and developing countries often suffer from heart attack or stroke due to arterial diseases leading to the malfunction of the cardiovascular system. Arteriosclerosis is one of many such diseases which appears in the form of abnormal or un-natural growth in the arterial lumen and creates obstruction to the normal flow of blood. This results in malfunction of the cardio vascular system causing sudden death of humans. Also, in many of the engineering problems fluid flow is affected by the constricted or expanded channel or tube. In a channel with constriction or expansion, separation can occur in the vicinity of the constriction or expansion when the flow rate exceeds a critical value. If flow occurs through a symmetric expansion then separation may occur in the either side of the main flow. What is observed is that although the flow region is symmetric but the separated regions may not remain same in size and the flow appears to attach to one or the other wall. Several theoretical and experimental studies of fluid dynamics through different geometries (constriction or expansion) have been carried out to evaluate the flow pattern and the shear stresses at the wall under steady and oscillatory flow conditions. The nonlinear separated vorticity modifies the boundary layer structure and its separated region which eventually changes the whole fluid dynamics. The dynamics of this kind of steady and unsteady flow phenomena and corresponding flow separation has been extensively studied by several researchers.

The phenomena of fluid flow separation in pulsatile flow has received considerable attention during the last few decades due to its practical applications in engineering and bio-medical system. One of the major tasks in analyzing such flow situations is to control the boundary layer separation as it imposes certain limitations on design and operation of many mechanical devices. The industrial and biological fluids are significantly affected by the application of the external magnetic field also ([1]). Human blood constitutes a suspension of red cells containing hemoglobin in plasma. It can be considered as an electrically low conducting fluid and are significantly affected by the application of external magnetic field ([2]). Blood flow in arteries are pulsatile in nature. The study of pulsatile blood flow in large arteries has been

motivated by researches because vascular fluid dynamics & hemodynamic factors play an important role in the development & progression of atherosclerotic diseases ([3], [4], [5]). Several researchers have analyzed the steady laminar flow through a constricted tube or channels([6],[7],[8]). The dynamics of pulsatile laminar flow phenomena over a contraction or expansion has been investigated & reported by many researches namely, Tutty ([9]), Liu & Yamaguchi([10]) Mittal et al. ([5]), Bandyopadhyay & Layek ([11]). The steady magneto hydrodynamic flow of an electrically conducting fluid in a channel with irregular geometries have been studied by Pal et al.([12]) & Midya et al.([13]) under laminar flow conditions in presence of a uniform transverse magnetic field.

Mathematical models of such problems can well be formed theoretically in the form of well posed boundary value problems. These are analyzed to estimate the patterns of the disturbed flow-field, the wall shear stress so that the influence of arterial construction on the flow phenomena can be measured theoretically. The validity of the mathematical model can also be established when one compares the theoretical results with the relevant experimental investigations.

Keeping this motivation in mind , we shall be able to deal with various problems concerning with constricted or expanded arterial flow through suitable mathematical models. Many numerical techniques would be of use in order to solve the problems numerically as the analytical methods often do not work for highly non-linear problems under propositions.

The main objective of our study is

1) to investigate the flow characteristics of pulsatile flow of an incompressible viscous fluid through a smoothly expanded channel. It may be of interest to find the relation between expansion height and flow separation.

2) to investigate the flow characteristics of pulsatile flow of an incompressible viscous fluid through a smoothly double expanded channel. It may also be of interest to find the relation between expansion heights and flow separation.

3) to investigate the flow characteristics of pulsatile flow of an incompressible viscous electrically conducting fluid with low conductivity through a smoothly expanded channel under external transverse uniform magnetic field. In this analysis we may neglect the induced magnetic field since the magnetic Reynolds number is very small and is found to be valid for the flow of liquid metals , human blood etc. (Shercliff [14]).

4) to investigate the flow characteristics of pulsatile flow of an incompressible viscous electrically conducting fluid with low conductivity through a smoothly double expanded channel under external transverse uniform magnetic field. In this analysis also we may neglect the induced magnetic field due to the reason stated above.

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